PLANTERS' BULLETIN

OF THE RUBBER RESEARCH INSTITUTE OF MALAYA

NEW SERIES NUMBER NINETEEN

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Price
50 Cents

July
1955

R R I

LOCATION. The institute's laboratories and offices are at the third mile, Ampang Road, Kuala Lumpur.

CORRESPONDENCE. All LETTERS must be addressed to the Director, Rubber Research Institute of Malaya, Post Office Box 150, Kuala Lumpur. Special inquiries may be marked for the attention of particular officers. The address for TELEGRAMS is Searching, Kuala Lumpur. TELEPHONE: Kuala Lumpur 3351. PARCELS occasionally arrive without any indication of their origin. Senders' names and addresses should be written clearly on the outside of all packages, and the institute should be advised of despatch by letter or telegram.

PROHIBITED PLANT SPECIMENS. Attention of planters and others in territories outside the Federation of Malaya and the Colony of Singapore is drawn to the Malayan Plant Importation Rules which prohibit the importation into Malaya of any part of a plant, whether living or dead, unless it is accompanied by a permit issued by the Director of Agriculture, Federation of Malaya. No permit will be issued in respect of any diseased plant or any plant pest. Any plant imported in contravention of these Rules (whose object is to prevent the introduction of diseases or pests) will be destroyed without examination. Anyone outside Malaya who desires our advice on any matter that may require examination of living material must first inquire by letter.

ADVICE. Inquiries are invited from rubber producers in the Federation of Malaya, the Colonies of Singapore and North Borneo, and the territories of Sarawak, Brunei and Nigeria, who may require more detailed information applicable to their own special problems. INTERVIEWS should be arranged by letter or telephone, as members of the senior research and advisory staff are frequently absent on visits to plantations. The institute is open from 8 am to 1 pm and 2 pm to 4 pm on Mondays to Fridays, and from 8 am to 12.30 pm on Saturdays.

EXPERIMENT STATION AND FACTORY. This station of the R R I is situated 16 miles from Kuala Lumpur, at Sungei Buloh on the Kuala Lumpur — Kepong — Kuala Selangor road. Visits may be made on Mondays or Wednesdays by arrangement. There is a guest house.

PUBLICATIONS. A list of 'Publications of the R.R.I.' is available on request. Subscription may be made by depositing $15 with us. An annual statement of account will then be submitted.

PLANTERS' BULLETIN

OF THE RUBBER RESEARCH INSTITUTE OF MALAYA

Kuala Lumpur July 1955 Number 19

Editorial: Life in Latex

The most fastidious gourmet of a microbe finds fresh latex rich in fare — amino acids, proteins, carbohydrates, and a delicate series of plant growth factors. Latex teems with life, and provides conditions for the growth of micro-organisms which are difficult to surpass. Indeed, bacteria multiply in fresh latex as rapidly as in the richest media prepared in the laboratory. Progress in latex bacteriology has been accelerated during the last six months by the discovery of a medium in which bacteria behave as they do in field latex, ammoniated field latex, and latex concentrate. They can now be observed cell for cell. Not only does this new medium permit the study of bacterial growth, but interesting biochemical reactions are revealed, including the production of acids and the reduction of sulphite to sulphide.

In our new laboratories on the Rubber Research Institute Experiment Station at Sungei Buloh the first stage of this work has been an identification of the different species of bacteria in latex. Three hundred distinct strains have been isolated, and many have been studied in detail. But, more important, the time taken for the bacterial population to double itself has been determined: it is about an hour in fresh latex. Some figures may serve to give an impression of the bacterial state; latex in the cup, an hour after tapping, contains about 8 million bacteria per cubic centimetre, which have originated from tree, tapping cup, and tapper. By the time the latex reaches the collecting bucket the figure has risen to 40 million. If no ammonia is added, latex eventually coagulates when the population is about 4,000 million per cubic centimetre.

These microbes have widely varying properties. Some, the aerobes, seem to be relatively harmless but the anaerobes (so called because they need no air for their survival) are most active in producing acids. When field latex is ammoniated to 0.3% by weight, as is usual for same or next day processing into concentrate, the bacteria are reduced in numbers but an alarming proportion survive — as many as 95% for some species. Worse, dominance shifts from the aerobes to the harmful acid producing anaerobes.

Fortunately the mean generation time of these bacteria is much higher under conditions of ammoniation, fifteen hours in fact, which is the reason why early ammoniation of field latex is able to prevent bulk coagulation during normal factory storage. We have to realise that as a killer of microbes in latex, weak ammoniation is a failure. It is a well established fact that the number of bacteria surviving any disinfecting process is directly proportional to the number initially present. Because of the high initial population in field latex, survival is considerable on ammoniation.

For latex concentrate, the position is more satisfactory. The bacterial cell is heavy — denser than latex serum — and centrifuging therefore removes large numbers of micro-organisms. The increase in ammonia concentration to 0.7% also reduces the population and rate of multiplication but more important is the reduction in the nutritional value of the medium, since the most readily available substrates (on which the bacteria subsist) are present in the serum. Thus bacterial survival immediately after centrifugal concentration is low, but the survivors continue their harmful metabolism just as in ammoniated field latex, although at a somewhat slower rate.

The method used for determining whether bacteria have been active in latex is the volatile fatty acid (VFA) test which measures the light organic acid endproducts produced up to the time of testing. This test is most useful in tracing a source of putrefaction in latex processing but by its nature it gives only an indication of the identity of the bacteria responsible. The number of bacteria present at the time of test is not indicated and consequently the future state of the latex is unspecified. The quality of latex on arrival in a consuming country will be affected by the number of live bacteria initially present. It is important that this should be as low as possible.

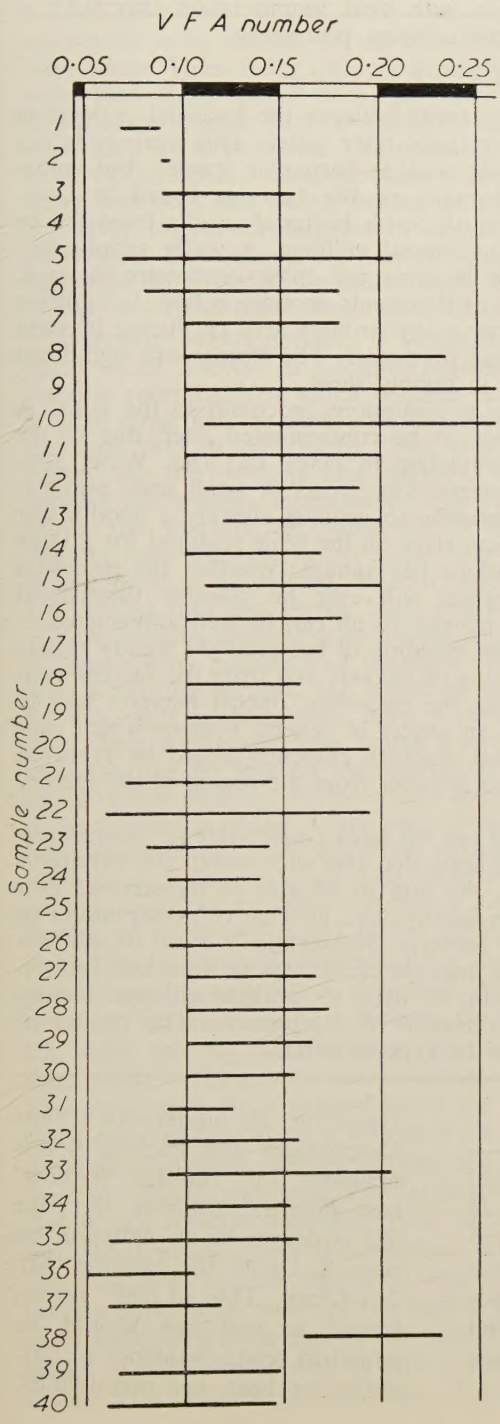
Although the VFA test records only a small group of the products of metabolism up to date and cannot communicate the viable state of the bacteria and other influencing factors, it is the best practical guide we have at the moment. Latex concentrate will normally be satisfactory on arrival provided the VFA number does not exceed our recommended maximum of 0.05 at the time of shipment. A latex with high VFA number may deteriorate rapidly. To illustrate this point the accompanying diagram shows the change in volatile fatty acid content of bulk latex shipments made some time ago, tested before despatch in Malaya and after arrival in the United States of America some six weeks later. The change for each sample is represented by the length of the bar. We readily see that a latex of moderately high VFA number may become much worse during the voyage.

It is common knowledge that latex stability is determined by the non-rubber constituents of latex. In infected latex — whether fresh, ammoniated, or concentrated — the amounts of individual non-rubbers vary continuously as bacteria break them down and resynthesise them. These changes together with chemical changes show up in the varying mechanical stability and other properties of concentrated latex, and in the variation in fraction removal when preparing pale crepe.

TACKLING A WORSENING SITUATION

Despite the present high level of ammoniation the problems of imperfect sterilisation are still with us. Just as the disease microbes of the human body are adapting themselves to the continued use of antibiotics such as penicillin, with the result that each such substance gradually becomes less effective, so the latex bacteria may be changing to more resistant forms.

If the bacterial population is evolving to meet the requirement of growth and survival at high ammonia concentration, the raising of the latter to a higher level for preserving latex concentrate — as some advocate — would only be a temporary expedient. After a few years this



higher concentration would exhibit the same defects as the present level. Working conditions are ideal for the continuous culture of ammonia resistant bacteria, and we may expect the position to get steadily worse.

We are therefore devoting our energies to alternative means of preservation and to wage war on the microbes. The processes which we are considering fall into two classes, physical and chemical.

Physical

Ultraviolet rays
Ultrasonic waves
X rays
Gamma rays

Chemical

Special detergents
Substrate imitants

Substrate imitants call for explanation. Decomposition occurs as a result of the bacteria digesting their foods, a process requiring enzymes; these enzymes in the bacterial cell act continuously on certain specific intermediate products in the process, and it is possible to arrest a process by blocking the enzyme; this is done by feeding it with some artificial substance very much like the natural intermediate (substrate) it works on, but which cannot be digested further. These inhibitors thus imitate the substrates.

At first sight the list may look formidable but the process we seek should save time and money. These envisaged processes

may be operated in conjunction with weak ammoniation – say 0.3% – to neutralise any acid production during processing.

WATER SUPPLIES

A remarkable formal similarity exists between the bacterial population of fresh latex and that of a typically poor water. This analogy is not only useful in guiding research towards particular species, but sometimes indicates the origin of many of the bacteria found in latex. Malayan waters vary tremendously, with bacterial counts from ten or less per cubic centimetre up to several millions. A water supply harbouring up to a few hundred bacteria per cubic centimetre is good, while one with a count of tens of thousands or more is bad. In addition it may be valuable to know how many strongly acid producing bacteria are present, and how many gas producers. The former are significant in latex technology, the latter in bubbly sheet.

Poor water supplies provide a continuous inoculum to the latex. A reasonably sterile latex is likely to be contaminated later, due to the lack of elementary hygiene prevailing in many factories. Water supplies are a matter of some concern, since costs of small scale purification are prohibitive. It is impossible to provide cheaply a good water supply from the normal Malayan river on the scale required for a large factory, say half a million gallons per annum. Whether the provision of adequate State water supplies will ever be possible throughout Malaya is not known but the benefits to all can be well appreciated.

Estate rivers are ideal for the breeding of bacteria; the steady supply of diluted latex from the washing of buckets and from the factory continuously provides nutrients for the microbes. Faecal bacteria add to this ideal system of culture — an aspect of general hygiene which cannot be too strongly emphasised. Factory effluents should be removed as rapidly and as completely as possible from the region of the factory and its water supply.

We seek a standard bacterial test for latex concentrate, to supplement the volatile fatty acid test. We hope that this will foretell the variations which will occur in shipment. We aim to be able to recommend new methods for cleanliness in the factory, and alternative preservatives to arrest the mass adaptation of bacteria. Meanwhile it is up to the factory manager to do all he can towards cleanliness in field and factory. For example, detergents should be used to provide efficient factory plant washing and partial sterilisation of components. The picture of a good English dairy is one to be kept in mind.

R. R. I. News

From the note on estimates for 1954 in *Planters' Bulletin 18* (page 55) it might be inferred that the Experiment Station ran at a loss. In fact, income exceeded expenditure by $182,325 but this was offset by a capital cost of $193,570.

Attention of holders of 'Type Descriptions and Packing Specifications for Natural Rubber' (see *Planters' Bulletin 18*, page 52) is drawn to an omission on page 8. Under the heading 'No. 2 — Clear Thin Light Brown Crepe' a final line should be added to read: 'evidence of oxidation or heat, not permissible'.

Termites

ALTHOUGH ALSO CALLED WHITE ANTS, termites are neither ants nor always white. There is for instance a nearly black termite which strips the outer bark from rubber trees, the pieces being carried by the workers in a long procession back to the nest. This is of no consequence as the inner bark is not removed. The resemblance to ants is only in the social habit, both ants and termites being differentiated into castes. True ants, along with bees and wasps, belong to the order Hymenoptera. Termites are lowly insects forming the order Isoptera which find their nearest relatives in the cockroaches and grasshoppers. Ants pass through grub and pupa stages before becoming adult, whereas a termite hatches from its egg in a form resembling the adult on a small scale.

A termite colony contains a larger number of castes than those of other social insects. In addition to the queen and consort there are standby reproductives which become functional if one or both of the original royal pair be destroyed. Thus disposing of the queen does not spell the ruin of the colony. The most conspicuous members of the colony are the workers and soldiers, among which both males and females are equally represented. The Hymenoptera are different here again, the workers all being sterile females. Termite workers and soldiers have minute eyes or none, they are wingless, and their sexual development is suppressed. In some species both workers and soldiers are divided into two forms, large and small.

New colonies arise from swarming flights of the winged sexual forms. A large colony releases vast numbers over a short season, usually after rain. Emerging at dusk and attracted to light these 'flying ants' are a familiar sight in the tropics. After a brief flight they fall to the ground, shed their wings and seek mates. Few survive the attentions of predators in the air and on the ground. If a male and female meet they search for a suitable crevice where they dig a nuptial chamber which is the beginning of the future nest. From this time onwards the female becomes sedentary, her abdomen enlarges enormously till she is little more than a bag of eggs. The number of eggs laid varies with the species, from two or three hundred a year in the less specialised forms to tens of thousands a day in the highly specialised forms.

The feeding habits of termites are diverse, though all of them consume vegetable material of some sort. Not all eat wood, still less living trees. In Malaya only one species, *Coptotermes curvignathus*, attacks the living tree to cause damage but other termites may feed on the dead wood of the rubber tree or on the outer bark as mentioned in the first paragraph. As a generalisation the raw food material gathered is eaten only by the workers, who feed the reproductives, the soldiers and the immature forms with secretions and partially digested food exuded from the mouth and anus. The large amount of cellulose in the termite diet is not directly digested. Many species harbour simple organisms (protozoa) which break the cellulose down to substances that the gut can deal with. Others take food that has been partly decomposed by fungi and bacteria. Some of the higher species (not the rubber tree termite) build fungal gardens at the nest. These sponge like structures are made of masticated wood on which certain fungi grow; they are consumed, it is believed, for the sake of accessory growth factors.

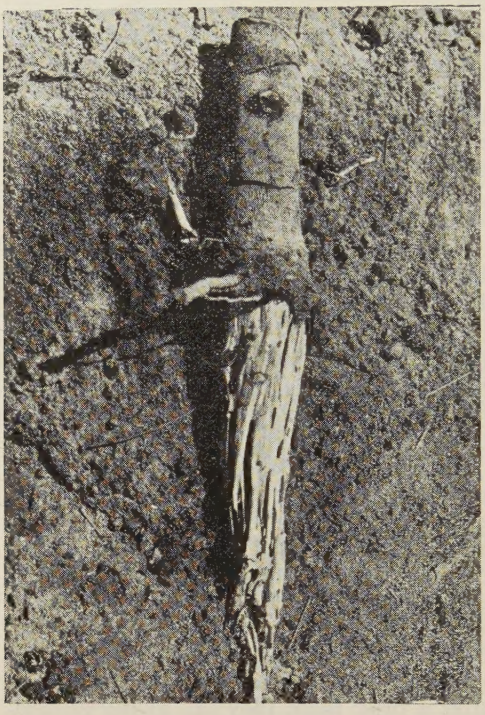
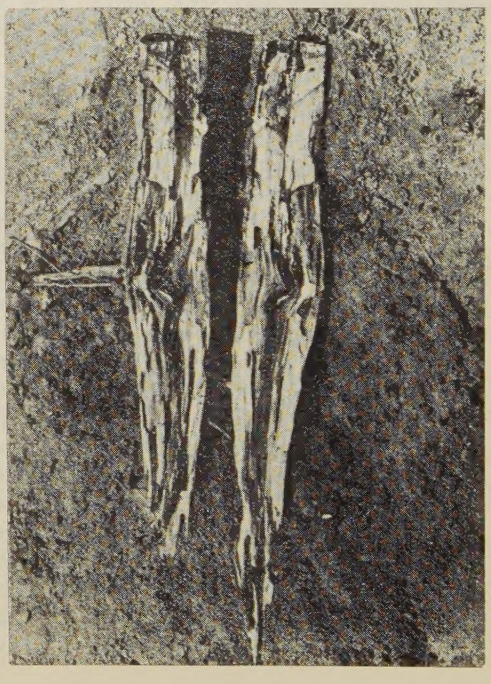


Figure 1. Budded stump killed by termites, pulled out of the ground to show how the tap root has been destroyed.

Not much is known about the factors limiting the increase of termites. They normally live in obscurity, but when their proective mudwork is broken true ants of many kinds will attack and carry them off. They are also preyed on by anteaters of which there is one species in Malaya, the pangolin (*Manis javanica*); they are a favourite food of birds and toads. Under artificial conditions many succumb to fungal and bacterial diseases which may also play an important role in nature.

Figure 2. The same stump split open to show termite galleries in the wood.



Their nests harbour many strange and highly specialised creatures which are tolerated and have little effect on natural control.

Termites fall into five main groups, or three if one ignores a genus that is primitive and another that is very unusual. The Calotermitidae, with relatively small colonies, include pests of furniture and timber. The most highly evolved, the Termitidae, have large colonies and include the builders of conspicuous nest mounds and the cultivators of fungal gardens. The intermediate group,

the Rhinotermitidae, includes the rubber tree termite. A gland which secretes a milky fluid is particularly well developed in the Rhinotermitidae, reaching its maximum development in the genus *Coptotermes* of which *curvignathus* is the largest local species. This makes recognition easy. When a soldier is disturbed it will grip the intruder with its mandibles and exude a drop of the milky fluid from the front of its head where the opening of the gland is situated. This fluid is sometimes mistaken for latex.

RUBBER TREE TERMITE

The rubber tree termite, along with many others, is indigenous to Malaya. When the jungle is felled for planting the rubber trees are attacked, but only by this one species. In general termites are beneficial in that they help to convert wood into humus. Areas where rubber was preceded by other crops are almost always free from termite trouble. Plantations established after clean clearing similarly are little affected. It is in new plantings from jungle felled without much clearing and with no burn that serious losses are likely to occur from termite attack.

The nest of *C. curvignathus* is subterranean, reputedly built within a submerged log or tree stump. Tunnels run through the soil for great distances in all directions, taking the termites to their feeding places. Trees attacked by one colony are not necessarily adjacent to each other, nor do they indicate even approximately where the nest is. Sometimes the tunnels from a central nest lead to a large stump or a hollow tree in which is a secondary nest. After this has acquired reproductives it may lead a more independent existence. Thus a network of tunnels extends out from the main nest through the plantation—to locate even a part of this labyrinth would be prohibitively expensive.

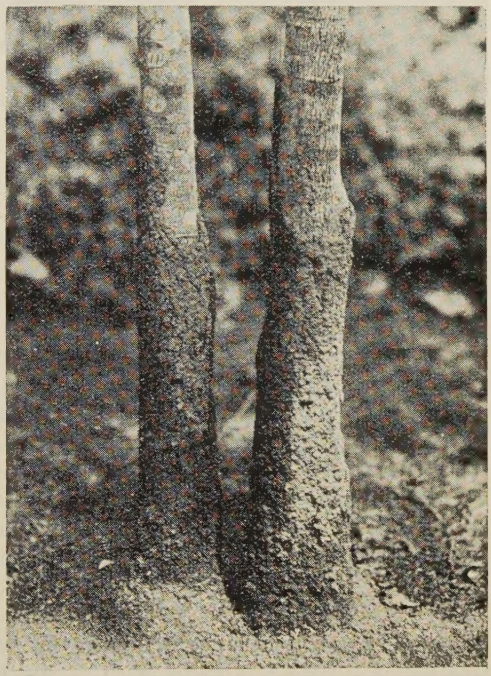


Figure 3. Two seedlings with termite mudwork covering the bases of the stems.

Trees with root disease are more readily attacked than are healthy ones presumably because the termites can then get into the heartwood without encountering latex, which is undoubtedly a serious barrier for them. A tree may show no outward sign of injury yet be blown over

in a high wind to reveal the tap root destroyed and the trunk honeycombed with termite galleries. Newly planted budded or seedling stumps are particularly liable to be attacked and are quickly killed; the root system is usually destroyed without the termites appearing above soil level. *Figure 1* shows such a stump pulled out of the ground, and *Figure 2* the same stump cut open to reveal the galleries in the wood containing many workers and a few soldiers.

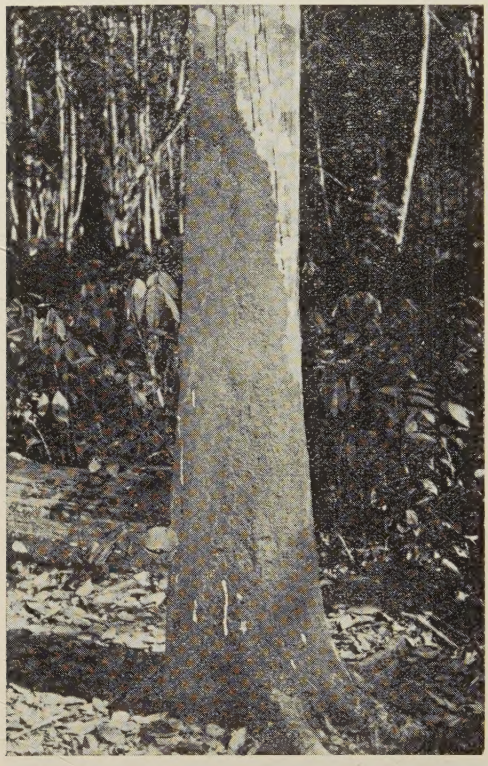


Figure 4. Tree in tapping attacked by termites, the lower part of the trunk encased in mudwork with latex oozing out where the pests have penetrated into the inner bark.

When termites attack a healthy tree they search for an easy point of entry. Their workings on the trunk are covered by mudwork 'trails' that may be so numerous and closely placed as to form a continuous sheet. *Figure 3* shows mudwork covering the bases of the stems of two seedlings planted at one point; *Figure 4* shows extensive workings on a tree in tapping. They may get through a wound or, with field buddings, they often first penetrate into the snag. In time they get into trees through intact bark. The outer layers are stripped off without difficulty, but when the inner bark is penetrated latex exudes (*Figure 4*). If left alone the pests ultimately succeed in forcing an entry into the wood which they proceed to hollow out as before.

Locating the nest of the rubber tree termite, in order to destroy it, is not a feasible operation. Moreover the elaborate structure of the colony leaves the majority of the pests inaccessible to insecticidal treatments. Contact is made with relatively few in the foraging parties. The only course open is to find out which trees are attacked and treat them to drive the termites away. Regular rounds of inspection are necessary in badly infested young rubber, an interval of a month between rounds being not too short. Treatment of attacked trees in mature rubber is less urgent. Rounds of inspection can be dispensed with, leaving the tappers to report new cases.

Two control procedures are recommended — the liquid method and the trail injection method. In the former the insecticide is poured round

the base of an attacked tree so as to run down by the tap root; if necessary a shallow channel is excavated round the tree to prevent the liquid from spreading unduly. The amount of solution required is about one or two pints depending on the size of the tree. Any mudwork on the trunk is scraped down before pouring the insecticide. Mercuric chloride (also called mercury bichloride or perchloride) as a 1% solution in water has given good results for many years but it can now be improved on. Some of the recently discovered insecticides persist for a long time in soil and are effective in quantities that make them cheaper to use than mercuric chloride. Three of them — aldrin, dieldrin and chlordane — have been under test on our Experiment Station for more than two years. Emulsions have been used because they penetrate soil easily. Various concentrations and quantities were tried. The results are impressive, for there have been no cases of reattack of trees treated with the concentrations advised below, and soil collected from plants treated in the field over two years ago is still toxic to termites in the laboratory. The locally available emulsifiable formulations of the three insecticides are Aldrex 2, Dieldrex 15 and Intox 8, containing aldrin, dieldrin and chlordane respectively. We recommend dilutions for Aldrex 2, 1 in 400; for Dieldrex 15, 1 in 300; and for Intox 8, 1 in 700. With any of these materials the cost of the chemical to treat a young tree is only about one cent — a small fraction of the cost of mercuric chloride. Their persistence in soil gives them a considerable protective value. Because of the low cost of the diluted insecticide it is likely to be economic to treat every tree in young areas that are found to suffer heavy termite damage.

In the trail injection method a small quantity of white arsenic is introduced into mudwork 'trails' on the stem of the attacked tree. Two small openings are made a few inches apart and the powder lightly blown in using a rubber bulb fitted with a fine nozzle. It is preferable to repeat the application at several places round the stem. Properly used white arsenic is rather more effective than mercuric chloride but has the drawback that it will cause bark burning if excessive quantities are applied to the bark of young trees or to the wet bark of older ones. Further, stringent regulations apply to the handling of all arsenicals. On the other hand the amount used is so small that the price of the poison is of little consequence. The treatment can be recommended for mature trees where termites persist even after application of the liquid method, that is, in cases where the insecticide cannot affect the termites within the bole.

CONCLUSION

In brief, the rubber tree termite is a serious problem only in new plantings where jungle growths remain. There is no feasible way of eradicating it. Attacked trees can be rid of the pest by a procedure that gives prolonged protection and is cheap enough to be applied to every plant in the worst affected areas of young rubber. By denying it access to the trees, *Coptotermes curvignathus* can be effectively equated with those many other termites that play a useful role in the soil. In time, as the vestiges of the jungle waste away, the pest will disappear.

Yield Graphs, Stock and Crop Records

We have pleasure in presenting a guest article by the Manager of Suffolk Estate, Sitiawan. This describes a comprehensive system for recording stock and stock-taking, crop and cropgrading, on a single form. Yield figures are ascertained on another form, which provides for their justification against total crop, month by month. Field graphs show clearly the trend of yield over the year, and the major factors influencing this.

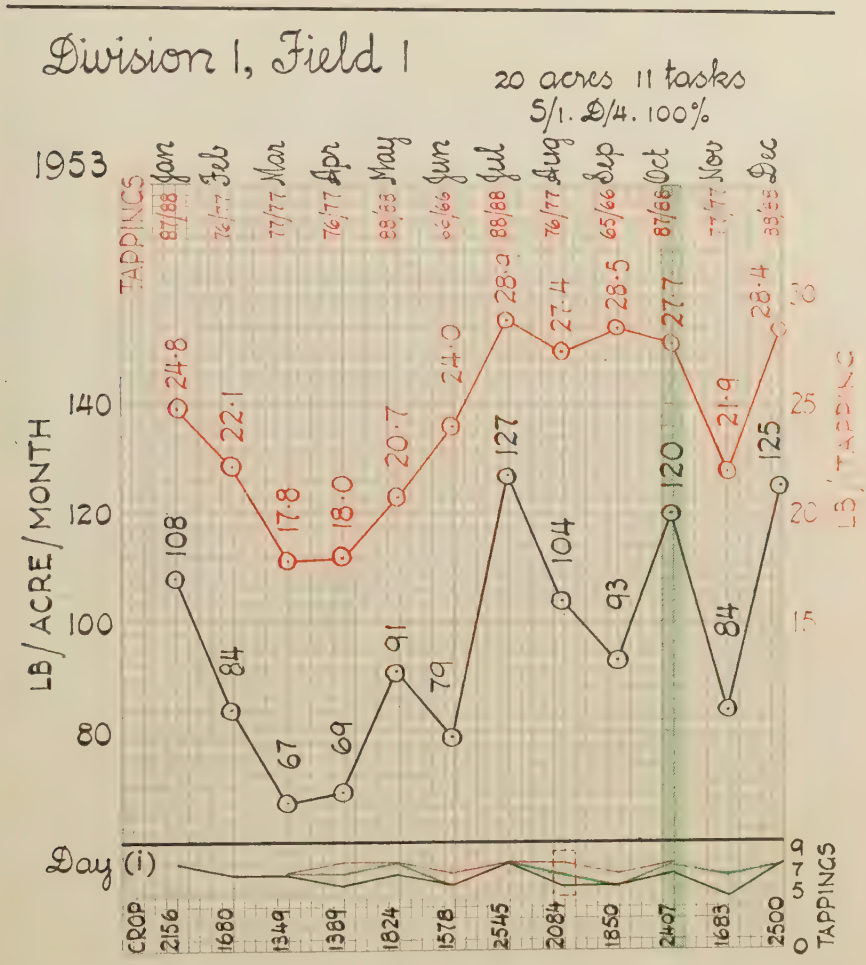
THE REASONS FOR DEVELOPING THIS METHOD were a desire to keep reliable figures with a minimum of bookwork, and to present them as simple graphs which would reveal yield trends at a glance, without the mental effort of mastering masses of tabled figures.

Field Graphs — A typical example is shown, adapted from actual estate records of 1953. These graphs are kept in a cheap school science exercise book: the ruled page opposite the graph paper is used for writing in notes on manuring, cultivation, stimulation, and tapping — anything likely to affect the yield trend.

Each field has a graph, showing monthly figures for a year. Along the bottom of the diagram the total crop in pounds is noted month by month. Similarly the absentee rate is noted along the top, as actual against maximum possible turnout on days when tapping took place — these figures are more practical than percentages. The two entries, for crop and absentee rate, are taken from a yield form, to be described later. By dividing the total crop figure for the month by the area of the field (see heading), points can be plotted for pounds per acre per month, giving the black yield curve (scale on left); by dividing the crop figure by the actual number of tappings the points on the red yield curve are obtained, representing pounds per tapper per tapping (scale on right).

Below the two yield curves is a three colour weather chart. The interpretation of yield fluctuations depends largely on this, for it shows the effect of weather on tapping days in the month. Consider the month of August on our illustration (red box indicates). The field was on an S/1.D/4 system, so there were eight possible tapping days as the calendar for 1953 shows. The top line gives this maximum number for the month. But reading up to the black line it appears that in that month measurements from individual tappers' buckets and scrap were possible on six days only. From black to green line is one space, representing one tapping day when individual measurements could not be carried out; rain precipitated early collection — a 'washout' — and such latex as was collected had to be coagulated without delay. (For such days the factory estimate of crop is apportioned to fields tapped in a manner described later.) From green to red line, again one space for August, indicates that weather entirely precluded tapping on one of the eight days scheduled on the calendar. Days precluded are not made up by tapping out of strict rotation on the estate concerned, but such a practice could be provided for by a yellow line.

We can now examine the yield curves shown. Yield per tapper (red) follows a satisfactory and typical wintering curve from the January to July. Such curves, particularly when they have been recorded for several years, can be of assistance in deciding wintering rates for contract



tapping. In our example, absentees are few and can be ignored — except for noting that yield per tapper is calculated on actual turnout, not on possible.

The black yield curve follows the red with such fluctuations as the weather chart can readily account for. Thus in June yield per tapper was rising steadily but yield per acre suffered a severe setback since there were only six actual tapping days that month, compared with eight in May and in July. Note that because of rain one of the days in May was calculated, not measured. For July to December the yield per tapper (red) was fairly consistent, and the yield per acre fluctuated in accordance with the effect of weather, as indicated on the chart. The November figures merit particular comment: the red curve plunges sharply, suggesting drastic interference. The weather chart shows that the full number of tappings were carried out — seven according to the calendar – but that rain interfered on two days and precluded measurement on the buckets. The inference is that these days were 'washouts',

and this could be verified at any future date from the crop book. The point to note is that the red curve is depressed far less, relative to the black, by days not tapped than by days with rain interference. When rain interferes latex is lost, but non-tapping days save bark for the wily tapper to exploit during the remainder of the month, within the limits of bark consumption imposed by the estate.

SELF ADJUSTING RECORDS

Yield figures which, when they are multiplied by the relative acreages, do not add up to the month's crop lead to confusion and recrimination. Crop figures which have to be adjusted after weighing or stocktaking are not conducive to accurate field yield figures which will, over the year, multiply up to give the exact annual crop. Further complication can arise when a variety of grades is manufactured, involving different processing times. Sole crepe is a pertinent example: a large number of grades are inevitable and manufacture is protracted unless drying is accelerated. Actual figures for each day's crop in terms of finally graded rubber cannot be achieved in practice, yet the year's crop must eventually tally with the graded rubber despatched. Stocks have to be checked monthly, against crop and despatches.

This problem of monthly reconciliation, with many grades and widely differing processing times, formerly caused the writer and his staff much trouble. The annual summary was even worse, so the following self adjusting system was developed whereby two forms enabled all crop, stocks, grades and despatches to be reconciled monthly and the results apportioned to fields for the purpose of yield records.

Crop Form — The basis of the system is the usual formula:

PREVIOUS STOCKS + CROP − DESPATCHED = PRESENT STOCKS

For convenience this has been changed around. See the first form 'Crop for *October* 1953'. The first four number columns comprise a PRESENT STOCKS list which can be drawn up by the factory conductor and rapidly checked by the manager. The next column adds DESPATCHES; the figures are entered by the factory conductor and checked by the office clerk against invoices. (This ensures agreement between factory and office in the matter of abstruse grades.) The following column of totals requires no explanation: from this the PREVIOUS STOCKS — the totals ascertained at the last stocktaking and entered in the next column — are deducted to give the 'Balance' column. The latter shows the production during the month in final grades, and also the change in position as regards rubber in the various processes of manufacture. There may well be less rubber at an incomplete stage of manufacture than there was the month before, so that a minus figure is quite in order in these boxes. Such figures are entered in red. CROP totals are obtained in the final column, after these adjustments for rubber processing (+ or −) have been taken into account with the figures for sales grades. The 'Balance' column affords reliable figures for assessing sales grades on a percentage basis.

The ledger-ruled crop form can be printed to suit the grades for any particular estate. Our example has been simplified and stylised for ease

Crop for October 1953

	Cases or Bales / GRADES ETC		STOCK END MONTH Packed	Loose	Total	Add SALES	TOTAL	Less PREVIOUS STOCK	BALANCE	CROP
SOLE CREPE	No 1 Exact	3	561	121	682	2240	2922	703	2219	
	others E.2	1	187	25	212	-	212	53	159	
	Total	4	748	146	894	2240	3134	756	2378	
	Off quality			20	20	-	20	20	-	
	Cuttings	1	160	10	170	-	170	50	120	
	TOTAL		908	176	1084	2240	3324	826	2498	
PALE CREPE	Wrappings*	(1)	13	-	13	-	13	-	13	
	No 1									
	No 2	1	160	30	190	-	190	70	120	
	Cuttings									
	Clippings									
TOTAL GRADED			1081	206	1287	2240	3527	896	2631	
Hand laminated				20						
Machine laminated										
Uncut				15	35	-	35	50	-15	
Total					1322	2240	3562	946	2616	
DRYING SHED					500	-	500	600	-100	
TOTAL LATEX CREPE					1822	2240	4062	1546	2516	2516
YELLOW FRACTION					288	112	400	100	300	300
R. S. S.	No 1	10	2240	105	2345	11200	13545	1046	12499	
	Cuttings			150	150	-	150	11	139	
	TOTAL				2495	11200	13695	1057	12638	
SMOKE HOUSE					1200	-	1200	1050	150	
TOTAL SMOKED SHEET					3695	11200	14895	2107	12788	12788
LATEX TOTAL										15604 A
SCRAP (D. R. C.)					1500	2240	3740	2000	1740	1740 B
GRAND TOTAL					7305	15792	23097	5753	17344	17344 C

* No 1 pale crepe used for wrapping bales of sole crepe cuttings

of interpretation. It provides for sole crepe, pale crepe and R.S.S. grades; yellow fraction and scrap are not milled on this estate, but sold loose ex estate — thus one line suffices for each. The lines which have to be added to arrive at the grand total entries at the foot of the form have been shaded green in the diagram for ease of reference; this is unnecessary in practice.

YIELD FOR. October .195.3

DAY	FIELD	TASKS	TAPPING DAYS				SCRAP			
			MAX	MD	NM	NT	MD	NM	TOT	72·5 %
i	Div 1 Field 1	11	8	7	1	-	230	30	260	188
ii	" " 2	10	7	7	-	-	280	-	280	203
iii	" " 3	10	8	8	-	-	284	-	284	206
iv	" " 4	11	8	7	-	1	276	-	276	200
	Total D/4						1070	30	1100	797
i/iii	Div 2 Field 5	18	16	15	1	-	660	40	700	508
ii/iv	" " 6	17	15	14	-	1	600	-	600	435
	Total D/2						1260	40	1300	943
	Estate Total						2330	70	2400	1740
									72·5%	

B

Yield Form — A second form links the total crop with the yield for each field, and provides the data for the field graph. For simplicity our hypothetical estate is taken to consist of six fields only, in two divisions. The number of tasks is shown against each field. Two tapping frequencies are used on this estate, alternate daily and fourth daily. The roman numerals *i, ii, iii, iv,* are applied to consecutive calendar days, and repeated without interruption throughout the years. Thus fields 1 and 5 are tapped on days designated (*i*), and field 5 (on alternate daily tapping) is also tapped on days designated (*iii*); days of alternate daily tappings are designated (*i*/*iii*) and (*ii*/*iv*). A bold line marked through all (*i*) days on a wall calendar serves as a ready reference as to which fields are being tapped on any given date.

To return to the form, the first figures are entered direct from the field tapping books. The number of tapping days are given as the maximum possible from the calendar (Max), the days on which individual buckets were measured (Md), days when measurement was precluded (NM), and days when tapping was not carried out (NT). At this stage

LATEX				TOTAL	ACRES	LB/ACRE	TAPPINGS		LB/TAPR
MD	NM	TOT	101·3 %				ACT	MAX	
1991	200	2191	2219	2407	20	120	87	88	27·7
1872	-	1872	1897	2100	18	117	69	70	30·4
2264	-	2264	2294	2500	20	125	78	80	32·1
2073	-	2073	2100	2300	22	105	70	77	32·8
8200	200	8400	8510	9307					
3741	200	3941	3992	4500	52	87	281	288	16·0
3062	-	3062	3102	3537	48	74	235	238	15·1
6803	200	7003	7094	8037					
15003	400	15403	15604	17344					

101·3%

A C

only the Md columns are entered up under the main heads 'Scrap' and 'Latex'; these figures are in pounds (wet weight for scrap). Next, the absentee figures are quickly ascertained by observing the number of untapped tasks in the field tapping books; this enables the columns under the head 'Tappings' to be completed.

For field 1, for example, we now have the following entries:

Tapping days 8/7/1/0 (compare weather chart in October);

Measured scrap (wet) 230 lb;

Measured latex 1991 lb;

Absentee figures 87/88 (the 'Max' was obtained by multiplying the number of tasks, 11, by the number of actual tapping days, 7+1; the book showed that one task was untapped, 88 – 1 = 87).

Note that field 4 has the same number of tasks as field 1, but as one day was not tapped the maximum possible total of tappings was only 77 for this field. The field graph for field 4 would show a different weather chart from that for field 1, which is illustrated; one field is on

(*i*) days, the other is on (*iv*) days. Days designated (*ii*), (*iii*), (*i*/*iii*), and (*ii*/*iv*) all have their different weather charts.

Adjustments — Yield figures for days when measurement was not possible have to be estimated. The gross factory estimate for each such day can be apportioned to the fields tapped that day. As a basis of apportionment for each field, the writer takes the percentage of the total estate yield on the corresponding tapping day last measured. The figures so obtained are conveniently noted in red ink on the summary page of the field tapping books, separately for scrap and for latex. These respective figures — totalled if a field has suffered more than one actual tapping day without measurement — are entered under the NM columns for 'Scrap' and for 'Latex'. Totals are then cross added by fields and grossed at the foot of the form to verify: 2,400 lb for scrap and 15,403 lb for latex in the example.

The final stage is to reconcile the yield figures on this form with the totals obtained on the crop form already described. The key figures from the crop form are entered at the foot of the yield form as shown (labelled A, B, C, in red, on both). The crop figure is then expressed as a percentage of the yield figure, for latex (A) and for scrap (B). These two percentages are then entered in the headings of the last columns under 'Latex' and 'Scrap', respectively.

In our example, the crop total for scrap is 1,740 lb (d.r.c.), comparing with a yield form total of 2,400 lb (wet). This gives a conversion percentage of 72.5%, which is quite reasonable when the accuracy of measuring wet scrap in lots of a few pounds at a time is considered. The conversion percentage of 101.3% for latex is also reasonable, considering the limitations of the Metrolac; the writer is perturbed only when this discrepancy exceeds 2% either way (except during wintering, when Metrolac measurements are less reliable).

Final figures are ascertained by applying the conversion percentage to the totals for latex and for scrap, firstly by divisions and then by fields. These figures should add up to the crop totals (A, B). A further cross check is obtained by adding latex and scrap totals for each field (final 'Total' column), which figures should gross to the estate grand total crop (C).

All that remains is to divide the total crop for each field by the area, and by the number of actual tappings, and enter the results in the columns for yield per acre (headed 'lb/acre') and for yield per tapper per tapping (final column).

The line of figures for field 1 on the yield form illustrated give all the data necessary for the corresponding month (October) on the field graph (green shading). Entering the actual yield figure against each plotted point is helpful and reduces errors.

As the illustration shows, the yield form can be typed as a stencil and copies run off on foolscap paper.

The system is much more difficult to describe than it is to operate. The usefulness of reliable graphs need not be emphasised here; the claims of the system to be comprehensive rely on the way in which every figure is interrelated and can easily be checked. For government and agents' returns the crop figure is available on the first of the month,

after stocktaking; no subsequent adjustment is necessary. In practice the daily totals of dried rubber from smoke house or drying shed seldom agree exactly with the annual record of rubber despatched; provided they tally with the monthly totals obtained in the crop form — a matter which can be checked in a few minutes — the latter figures can be regarded as reliable and used for all purposes. Operation of the system may take a little time and trouble but it certainly eliminates muddle and simplifies annual summaries. The writer has yet to hear of a routine which saves more time in checking, reconciling, and adjusting.

By courtesy of Dinding's Rubber Estates Ltd, Ipswich, England.

N.S. Maccoll

Yield Stimulation with 2,4,5-T

THE IDEA OF INCREASING THE YIELD of rubber trees by stimulation is not recent. As early as 1912 the practice of scraping the outer layer of bark from below the tapping cut was found effective, and smallholders later applied substances such as cowdung and termite earth in order to increase both yield and bark renewal.

In the 'twenties proprietary mixtures such as Neubark and Solar Vim appeared on the market, but without much response from estates. In 1929-30 experiments with bark scraping and the application of nitrate of soda, wood ash, and cattle manure, were carried out under our aegis on several estates; yield increases were recorded.

Systematic research into the nature of the stimulating agents started with experiments with vegetable and mineral oils applied to scraped bark below the tapping cut; these soon showed that plant hormones in the vegetable oils were responsible for the increases in yield. Subsequent trials with synthetic hormones (plant growth substances) in oil carriers revealed the highly stimulating effects of the chemicals known as 2,4-D and 2,4,5-T. Two proprietary mixtures containing 2,4-D, Stimulex and Eureka, became available.

In our experiments, preparations with 2,4,5-T have surpassed in performance those with 2,4-D and results achieved enable us now to draw practical conclusions. The normal butyl ester of 2,4,5-T gives excellent results at a concentration of one per cent (acid equivalent) in a mixture of five parts of palm oil to three parts of an inert petrolatum such as Standard Vacuum Product 2295C or Shell Otina Compound. We can provide instructions for preparing this mixture, but recommend the use of standard preparations* of our formulation for convenience and to avoid mistakes. No change should be made in the composition of the ready made mixture. The mode and frequency of application will depend on the tapping system, and on the quality of the trees.

* *Malayan Fertilisers Ltd. and Imperial Chemical Industries (Malaya) Ltd, market these at a price of $5.85 for a one gallon tin and $20 for a four gallon tin.*

APPLICATION BELOW THE TAPPING CUT

Half circumference cut — The stimulant should be applied to a 3 inch strip of lightly scraped bark immediately below the tapping cut. Besides some stimulating effect in itself, scraping removes the dead outer corky tissues which would hinder the penetration of the mixture into the tree. For thick virgin bark a hard steel scraper is convenient but for removing the cork layers of thin bark a stiff steel wire brush is recommended as it is flexible and does not cause serious wounding. The design of scraper used in our experiments, for virgin or thick renewed bark, appears in *Figure 1*. As it is exactly three inches wide it serves as a measure for the width of the strip to be scraped.

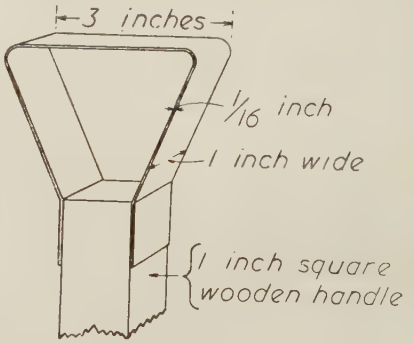


Figure 1. Hard steel scraper for thick bark.

After the latex exuded has coagulated, this is wiped off with a rag to prevent thickening of the stimulant. The latter is painted on thinly and evenly with a flat brush.

The damage shown in *Figure 2* results from a thick application of the mixture: excess has run down the scraped surface to accumulate in the unscraped bark beneath. This swollen bark yields only from the innermost latex vessels; extreme cases go completely dry. Heating the mixture results in similar damage (*Figure 3*). Care is needed to prevent the stimulant from getting on to the renewing bark above the cut — this leads to irregular bark renewal.

Figure 2. Bark damage due to excessive application of yield stimulant.

Trees which are due to be cut out for replanting in four or five years may be treated at six monthly intervals; those intended for a longer life should be treated annually.

A gang of six is satisfactory in practice, five to scrape and one to paint; each scraper works along one row while the painter works across the rows. Such a gang can treat 400 to

600 trees per day, depending on size, and a gallon of the mixture suffices for 400 to 800 trees on half circumference tapping. Total cost per tree, including labour and material, is within a cent of $3\frac{1}{2}$ cents.

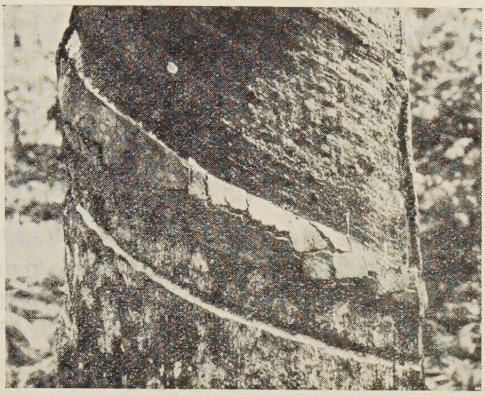


Figure 3. Damage resulting from heating the mixture.

Fourth day tapping – For systems with full circumference, or two half circumference cuts, we suggest treatment of a strip not wider than $1\frac{1}{2}$ inches below each cut. We have tried a 3 inch strip in trials on nine clones tapped 2S/2. d/4.100% on poor second renewal bark; after a high peak the yield dropped well below that of untreated trees. An estate on the same tapping system has reported good results from treatment of a strip only $1\frac{1}{2}$ inch wide, below both cuts.

Slaughter tapping — The article 'Tapping Prior to Replanting' contains our recommendations (*Planters' Bulletin 15*, page 103). We advise slaughter tapping over a period not exceeding one year. During that period tapping may be fourth daily on three or four cuts, two of which are preferably tapped upwards. Yield stimulant should be applied every four months to the two high cuts only — on a 3 inch strip of lightly scraped bark above the upward cut(s), and if one of the high cuts is downward, below that cut. Such low intensity slaughter tapping systems, combined with fourth monthly application of stimulant, have proved superior to more drastic methods of tapping.

APPLICATION ABOVE THE TAPPING CUT

A new method, which is giving promising results in our experiments, is to apply the yield stimulant above the tapping cut at monthly intervals to the width of bark excised during the previous month. This greatly increases yield, but without the usual high peak. The rise is more gradual and is sustained for a long period — over two years in one of our trials. *Figure 4* shows how the effect differs from that of the more usual practice of applying the stimulant below the cut; over a period of six months the new method is clearly superior but only a long term comparison can show which of the two techniques is to be preferred.

Application of a yield stimulant above the cut also results in a highly increased rate of bark renewal, but apparently during the first year only. The extra thickness of the renewed bark is uneven (*Figure 5*) and contains no latex bearing tissues. We cannot recommend this new method of application, unless our long term experiments show no adverse effects on yield, brown bast, and yield capacity of the renewed bark.

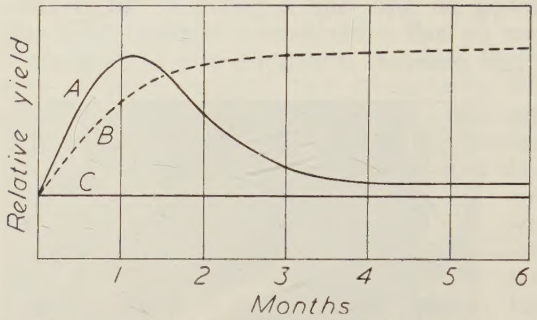


Figure 4. Compare two methods of yield stimulation.

A — *Normal application below the cut (six monthly)*

B — *Application to the renewing bark above the cut (monthly)*

These two are plotted as relative yields, expressed as percentages of the corresponding yield of untreated control plots, C. Subsequent applications repeat the peak effect for treatment A, while a steady trend is maintained for B. In the fullness of time the yield trend of B may decline.

CONCLUSION

The best results from the use of yield stimulants are obtained with healthy trees with virgin or good renewed bark. We do not recommend the treatment of young high yielding material, as this may well affect growth adversely — experiments are in progress. On old trees thin corrugated renewed bark is not worth treating; for such we advise the opening of high cuts in virgin bark, which may be treated to increase yields to a most satisfactory level.

When, in tapping, the cut approaches the junction of bark of different ages (e.g. when a high cut on virgin bark approaches the renewed bark below) the yield falls; A single application of yield stimulant is recommended to maintain the level of yield.

Half yearly applications are best done early in May and November in Malaya; if only one application is given per year this should be early in November. Late dripping is usual during the first month after treatment, and collection of latex should be delayed at least an hour. Sometimes a second collection is jusified at peak yield periods.

The level of increased yield cannot be predicted— so much depends on the quality of the trees and on conditions of environment.

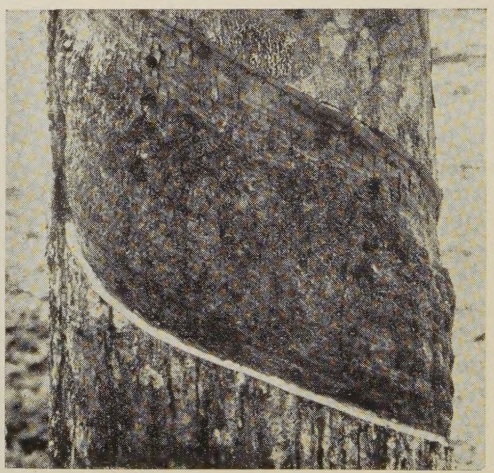


Figure 5. Renewed bark after monthly application of yield stimulant above the tapping cut.

R.R.I. Lectures to Planters

A revised list of lectures available during the latter half of 1955 follows. Early application is recommended and an alternative choice should be given, to avoid disappointment.

SOILS DIVISION

G. OWEN: *Soils and the nutrition of the rubber tree*

BOTANICAL DIVISION

C.W. BROOKSON: *Improvement of hevea*

P. DE JONGE: *Yield stimulation*

P.R. WYCHERLEY: *Hevea planting material*

PATHOLOGICAL DIVISION

F.W. HUTCHISON: *Root diseases*

R.N. HILTON: *Windborne diseases*

CHEMICAL DIVISION

P.F. MAHER (before October): *Recent improvement in T.C.R.*

J.E. MORRIS: *Control of latex quality*

Inquiry should be made of the Director

No Longer Available

Planters' Bulletin 2,6,7 and *8* are out of stock. A set of back issues, complete except for these four, can be provided post free in Malaya for $7.50. Reprints of the more important articles which appeared in the missing issues can be provided free of charge in lieu.

OUR FRONT COVER SHOWS SIR DONALD MACGILLIVRAY, HIGH COMMISSIONER, ON A VISIT TO THE R.R.I. EXPERIMENT STATION AT SUNGEI BULOH.

By courtesy of Department of Information

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